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(54)【発明の名称】　アーク溶接機

1

(57)【特許請求の範囲】

【請求項１】溶接トランスの２次側に整流回路を接続し、その出力端に２個のコンデンサの直列回路と２個のスイッチング素子の直列回路をそれぞれ接続し、２個のコンデンサの直列接続の中点と２個のスイッチング素子の直列接続の中点との間に溶接負荷を接続し、前記２個のスイッチング素子のうち一方のスイッチング素子を駆動するドライブ信号回路Ａと、そのドライブ信号回路Ａの反転信号を出力し他方のスイッチング素子を駆動するドライブ信号回路Ｂと、前記２つのドライブ信号回路Ａ，Ｂのバルス周期を決定する発振回路と、その発振回路が一定の周期で発振と停止動作を繰り返すための信号をその発振回路に入力するタイマー回路を備えたアーク溶接機。

【請求項２】発振回路のバルス幅調整回路を設けた請求項１記載のアーク溶接機。

2

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、アルミニウムやマグネシウムなど酸化皮膜除去を必要とする材料の溶接に使用されるアーク溶接機に関する。

【０００２】

【従来の技術】従来、アルミニウムやマグネシウムなど溶接時に酸化皮膜除去を必要とする材料の溶接には交流アーク溶接機が使用され、図３に従来の交流アーク溶接機の回路構成の一例を示す。

【０００３】図３において、１は商用電源、２と５は整流ダイオード、３はスイッチング素子、４は溶接トランス、６ａと６ｂはコンデンサ、７は被溶接物、８はアーク負荷、９は電極、１０ａと１０ｂはスイッチング素

子、１１ａはスイッチング素子１０ａを駆動するドライブ信号回路Ａ、１１ｂはスイッチング素子１０ｂを駆動するドライブ信号回路Ｂ、１２はドライブ信号回路Ａ１１ａおよびドライブ信号回路Ｂ１１ｂのパルス周期を決定する発振回路、１３は反転器である。

【０００４】図３に示す回路において、商用電源１を整流ダイオード２で整流し、その整流出力をスイッチング素子３でスイッチングし、その交流出力を溶接トランス４で降圧絶縁し、その出力端に２個のコンデンサ６ａと６ｂの直列回路と２個のスイッチング素子１０ａと１０ｂの直列回路をそれぞれ接続し、２個のコンデンサ６ａと６ｂの接続点と２個のスイッチング素子１０ａと１０ｂの接続点の間に溶接負荷、すなわち被溶接物（母材）７と電極９とアーク８を接続し、２個のスイッチング素子１０ａと１０ｂの内、一方のスイッチング素子１０ａにドライブ信号回路Ａ１１ａを接続し、他方のスイッチング素子１０ｂにはドライブ信号回路Ｂ１１ｂを接続し、さらにドライブ信号回路Ａ１１ａには発振回路１２の出力パルスが直接に、ドライブ信号回路Ｂ１１ｂには発振回路１２の出力が反転回路１３によって極性が反転されて接続されている。

【０００５】発振回路１２の出力波形に同期したパルス出力がドライブ信号回路Ａ１１ａから出力され、スイッチング素子１０ａのＯＮ・ＯＦＦを繰り返す。一方、ドライブ信号回路Ｂ１１ｂには発振回路１２の出力が反転器１３で反転して入力されているので、ドライブ信号回路Ｂ１１ｂはスイッチング素子１０ａとは交互にスイッチング素子１０ｂをＯＮ・ＯＦＦさせる。

【０００６】この動作によりスイッチング素子１０ａがＯＮし、スイッチング素子１０ｂがＯＦＦのときには、電流はスイッチング素子１０ａ→電極９→アーク負荷８→被溶接物７→コンデンサ６ｂの経過で流れ、逆にスイッチング素子１０ａがＯＦＦでスイッチング素子１０ｂがＯＮの場合には、電流はコンデンサ６ａ→被溶接物７→アーク負荷８→電極９→スイッチング素子１０ｂと流れる。したがってアーク負荷８には図４に示す交流電流が流れる。

【０００７】アーク負荷８に電極９側がプラスの電流が流れている期間には、被溶接物７の母材より融点の高い酸化被膜を除去する作用があり、電極９側がマイナスの期間においては、被溶接物７を溶かす作用が強いため、アルミニウムやマグネシウム等の溶接にはこの種の交流アーク溶接機が使われていた。

【０００８】

【発明が解決しようとする課題】しかし、上記した交流アーク溶接機では、アルミニウム材やマグネシウム材の溶接を行った場合、アークの指向性が悪いため、

（１）　隅肉溶接が難しい

（２）　裏波溶接が難しい

等の欠点があり、また極性反転時の高調波のため、



（３）　アーク音が高い

さらに、電極側＋の電流が流れるときの電極加熱効果により

（４）　電極消耗が速い

等の問題点があった。

【０００９】本発明は、上記の従来の問題を解決しようとするもので、アーク指向性と安定性を増加させ、また電極加熱効果を減少させて、隅肉溶接と裏波溶接を行うことを容易にすると同時に電極の消耗を抑制し、さらにアーク音を低減させることを目的とする。

【００１０】

【課題を解決するための手段】上記の目的を達成するために、本発明のアーク溶接機は溶接用トランスの２次側に整流回路を接続し、その出力端に、２個のコンデンサの直列接続回路と、２個のスイッチング素子の直列接続回路とをそれぞれ接続し、２個のコンデンサの直列接続の中点と２個のスイッチング素子の直列接続の中点の間に溶接負荷を接続し、前記２個のスイッチング素子のうち一方のスイッチング素子を駆動するドライブ信号回路Ａと、そのドライブ信号回路Ａの反転信号を出力し他方のスイッチング素子を駆動するドライブ信号回路Ｂと、前記２つのドライブ信号回路ＡとＢのパルス周期を決意する発振回路と、その発振回路が一定の周期で発振と停止動作を繰り返すための信号をその発振回路に入力するタイマー回路を備えた構成にしたものである。

【００１１】

【作用】上記した構成により、従来の交流電流に電極側マイナスの直流電流が周期的に混合されることになり、交流特性に電極側マイナスの直流特性が加わることになる。これにより、電極側マイナスの期間においては電極が熱陰極となり極点が安定するためアークの指向性が増し、アークが安定し、かつ電極側プラスの場合のような電極加熱効果がなく電極の消耗が抑制される。また直流混合時には極性反転がないため高調波による騒音がなくなり、アーク音が低減する。

【００１２】

【実施例】以下、本発明の交流アーク溶接機の一実施例について図面を参照しながら説明する。

【００１３】図１において、主回路構成は従来例を示す図３と同じであるので、溶接トランス４の一次側は省略してある。また、その他の部分についても、図３と同じ部分については同じ符号を付し、異なる部分について説明する。図１において、１４はタイマー回路、１５はパルス幅調整回路である。

【００１４】図１に示す回路において、タイマー回路１４が一定の周期でＯＮとＯＦＦを繰り返すと発振回路１２が連動して、タイマー回路１４がＯＮの時に発振回路１２が発振し、タイマー回路１４がＯＦＦの時に発振回路１２は発振を停止し、タイマー回路１４と発振回路１２はこの動作を繰り返す。タイマー回路１４がＯＮの場

5

合には従来例と同様に、スイッチング素子１０ａと１０ｂを交互にＯＮ・ＯＦＦさせる信号を発振回路１２からの信号に基づいてドライブ回路Ａ１１ａとドライブ回路Ｂ１１ｂが出力するため、図２に示すように$T_{AC}$の期間、交流電流が流れる。一方、タイマー回路１４がＯＦＦの場合には、発振回路１２は発振を停止するが、スイッチング素子１０ａはＯＮを、スイッチング素子１０ｂはＯＦＦを続けるため、電流はコンデンサ６ａ→被溶接物７→アーク負荷８→電極９→スイッチング素子１０ｂと流れ、図２に示すように$T_{DC}$の期間、電極側マイナスの直流電流が流れる。

【００１５】このようにタイマー回路１４のＯＮ・ＯＦＦに応じて交流電流と直流電流が交互に流れる混合電流を容易に得ることができる。したがってタイマー回路１４の時限設定次第で、直流電流期間比率＝$T_{OFF}$／（$T_{ON}+T_{OFF}$）＝$T_{DC}$／（$T_{AC}+T_{DC}$）を自由に選ぶことができる。

【００１６】また、上記直流電流期間比率を固定した場合でも、パルス幅調整回路１５により発振回路１２の発振動作時におけるパルス幅を狭めると、ドライブ信号回路Ａ１１ａのパルス幅は狭く、ドライブ信号回路Ｂ１１ｂのパルス幅は広くなり、それに伴ってスイッチング素子１０ｂの導通期が広がり電極側マイナスの電流の比率が大きくなるので、直流電流期間比率を大きくしたのと同じ効果が得られ、熱陰極放電の期間比率が大きくなり、アークの指向性と安定性が増し、また電極加熱効果が小さくなり電極消耗が抑制される。

【００１７】

【発明の効果】以上の説明から明らかなように本発明に＊

6

＊よれば、交流電流期間と電極側マイナスの直流電流期間を周期的に交互に繰り返し、直流電流期間の比率を大きくしてアーク溶接を行うことにより、熱陰極放電の期間比率が大きくなり、この期間は極点が安定するため、アークの指向性と安定性が増してアルミニウムやマグネシウムなどの隅肉溶接や裏波溶接を容易にし、電極側プラスの場合に発生する電極加熱効果を減少させて電極消耗を抑制する。さらに、直流電流期間を設けることにより、極性反転時の高調波発生が少なくなり、アーク音を低減させる効果もある。

【図面の簡単な説明】

【図１】本発明のアーク溶接機の一実施例を示す回路構成図

【図２】同実施例における出力電流の波形図

【図３】従来例における回路構成図

【図４】従来例における出力電流の波形図

【符号の説明】

４　溶接トランス

５　整流ダイオード（整流回路）

６ａ，６ｂ　コンデンサ

７　被溶接物

８　アーク負荷

９　電極

１０ａ，１０ｂ　スイッチング素子

１１ａ　ドライブ信号回路Ａ

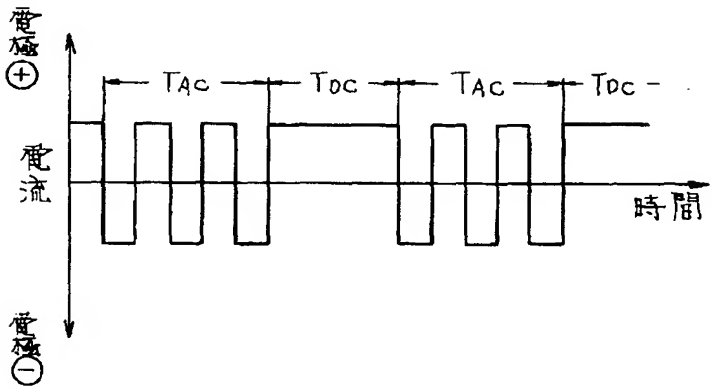
１１ｂ　ドライブ信号回路Ｂ

１２　発振回路

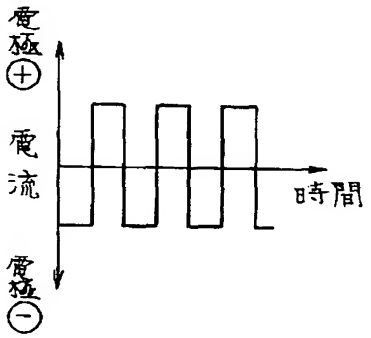
１４　タイマー回路

１５　バルス幅調整回路

【図２】

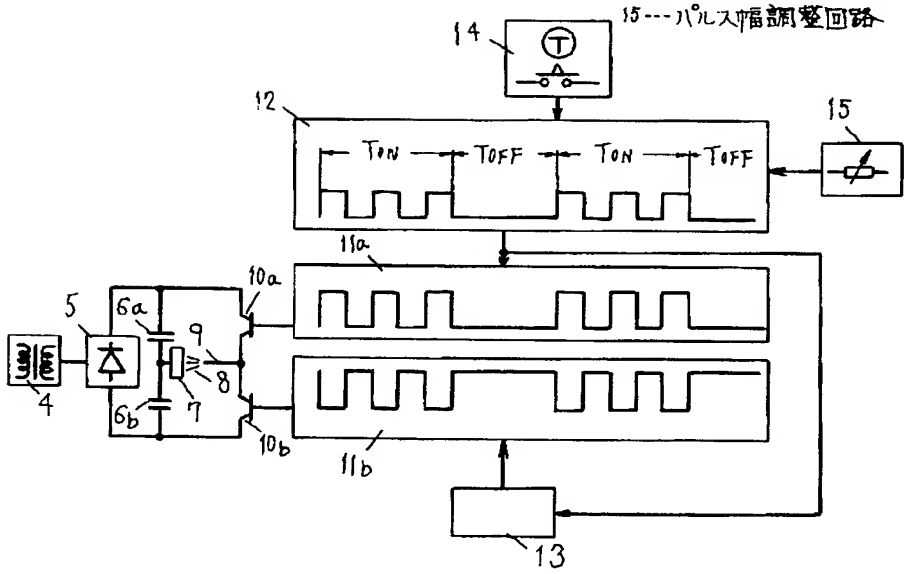



【図４】

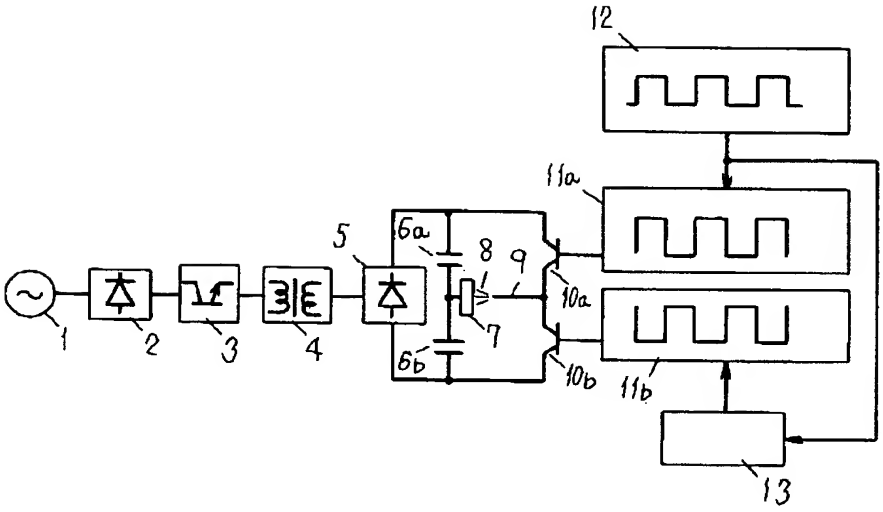


【図１】

4---溶接トランス
5---整流ダイオード(整流回路)
6a,6b---コンデンサ
7---被溶接物
8---アーク負荷
9---電極
10a,10b---スイッチング素子
11a---ドライブ信号回路A
11b---ドライブ信号回路B
12---発振回路
14---タイマー回路
15---パルス幅調整回路



【図３】



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Applicant: Matsushita Denki Sangyo Co., Ltd.
Inventors: Seigo Hagiwara et al.
Title of the Invention: Arc Welding Method

CLAIMS

(57) [Claim(s)]

[Claim 1] The arc welder characterized by providing the following. The drive signal circuit A which connects a rectifier circuit to the secondary of a welding transformer, connects the series circuit of two capacitors, and the series circuit of two switching elements to the outgoing end, respectively, connects a welding load between the middle point of the series connection of two capacitors, and the middle point of the series connection of two switching elements, and drives one switching element between the two aforementioned switching elements. The drive signal circuit B which outputs the reversal signal of the drive signal circuit A, and drives the switching element of another side. The oscillator circuit which determines the pulse period of the two aforementioned drive signal circuits A and B. The timer circuit which inputs the signal for the oscillator circuit repeating an oscillation and halt operation a fixed period into the oscillator circuit.

[Claim 2] The arc welder according to claim 1 which formed the pulse width equalization circuit of an oscillator circuit.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the arc welder used for welding of the material which needs oxide-film removal, such as aluminum and magnesium.
[0002]
[Description of the Prior Art] Conventionally, an AC arc welding machine is used for welding of the material which needs oxide-film removal at the time of welding, such as aluminum and magnesium, and an example of the circuitry of the conventional AC arc welding machine is shown in drawing 3 .
[0003] In drawing 3 1 rectifier diode and 3 for a source power supply, and 2 and 5 A switching element, In 4, a welding transformer, and 6a and 6b a weldment-ed and 8 for a capacitor and 7 An arc load, The drive signal circuit A to which 9 drives an electrode and, as for a switching element and 11a, 10a and 10b drive switching element 10a The oscillator circuit as which the drive signal circuit B to which 11b drives switching element 10b, and 12 determine the pulse period of drive signal circuit A11a and drive signal circuit B11b, and 13 are inverters.
[0004] In the circuit shown in drawing 3 , a source power supply 1 is rectified by rectifier diode 2. Switch the rectification output with a switching element 3, and the pressure-lowering insulation of the ac output is carried out by the welding transformer 4. The series circuit of two capacitors 6a and 6b and the series circuit of two switching elements 10a and 10b are connected to the outgoing end, respectively. Between the node of two capacitors 6a and 6b, and the node of two switching elements 10a and 10b, a welding load, An arc 8 is connected with the weldment 7-ed (base material) and an electrode 9. Namely, the inside of two switching elements 10a and 10b, Drive signal circuit A11a is connected to one switching element 10a. Drive signal circuit B11b is connected to switching element 10b of another side, the output of an oscillator circuit 12 is reversed by further drive signal circuit A11a, polarity is directly reversed by drive signal circuit B11b by the inverter circuit 13, and the output pulse of an oscillator circuit 12 is connected.
[0005] The pulse output which synchronized with the output wave of an oscillator circuit 12 is outputted from drive signal circuit A11a, and repeats ON-OFF of switching element 10a. On the other hand, since the output of an oscillator circuit 12 is reversed and inputted into drive signal circuit B11b by the inverter 13, drive signal circuit B11b is made ON-OFF [ a / switching element 10/ switching element 10b ] by turns.
[0006] the time of switching element 10a turning on by this operation, and switching element 10b being OFF -- current -- the switching element 10a-> electrode 9 -- the case where it flows by progress of weldment-ed [ -> arc load 8 -> ] 7 -> capacitor 6b, and switching element 10a is [ switching element 10b ] ON in OFF conversely -- current -- capacitor 6a-> -- -ed -- it flows with weldment 7 -> arc load 8 -> electrode 9 -> switching element 10b Therefore, for the arc load 8, the alternating current shown in drawing 4 flows.
[0007] The period when the current of plus of an electrode 9 side for the arc load 8 is flowing had the operation which removes the high oxide skin of the melting point from the base material of the weldment 7-ed, and since the operation to which an electrode 9 side melts the weldment 7-ed in the period of minus was strong, this kind of AC arc welding machine was used for welding of aluminum, magnesium, etc.
[0008]
[Problem(s) to be Solved by the Invention] however, the case where welding of aluminum material or magnesium material is performed in the above-mentioned AC arc welding machine -- since the directivity of an arc is bad -- (1) (2) with difficult fillet weld since there is a fault, like Uranami welding is difficult and it is a higher harmonic at the time of inversion -- (3) the electrode heating effect which is a time of the current of electrode side + flowing further that arc sound is high -- (4) There were troubles, like an electrode wear is quick
[0009] this invention tends to solve the above-mentioned conventional problem, and makes arc directivity and stability increase, and decreases the electrode heating effect, it suppresses consumption of an electrode at the same time it makes it easy to perform fillet weld and Uranami .

welding, and it aims at reducing arc sound further.
[0010]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the arc welder of this invention connects a rectifier circuit to the secondary of the transformer for welding. to the outgoing end The series-connection circuit of two capacitors, Connect the series-connection circuit of two switching elements, respectively, and a welding load is connected between the middle point of the series connection of two capacitors, and the middle point of the series connection of two switching elements. The drive signal circuit A which drives one switching element between the two aforementioned switching elements The drive signal circuit B which outputs the reversal signal of the drive signal circuit A, and drives the switching element of another side It is made the composition equipped with the oscillator circuit which decides the pulse period of the two aforementioned drive signal circuits A and B, and the timer circuit which inputs the signal for the oscillator circuit repeating an oscillation and halt operation a fixed period into the oscillator circuit.
[0011]
[Function] By the above-mentioned composition, the direct current of electrode side minus will be periodically mixed by conventional alternating current, and an alternating current property will be joined by the direct-current property of electrode side minus. Since an electrode turns into hot cathode in the period of electrode side minus and the pole is stabilized by this, the increase of the directivity of an arc and an arc are stabilized, and there is no electrode heating effect like [ in the case of being electrode side plus ], and consumption of an electrode is suppressed. Moreover, since there is no inversion at the time of direct-current mixture, the noise by the higher harmonic is lost, and arc sound decreases.
[0012]
[Example] Hereafter, it explains, referring to a drawing about one example of the AC arc welding machine of this invention.
[0013] In drawing 1 , since main circuit composition is the same as drawing 3 which shows the conventional example, the upstream of the welding transformer 4 has been omitted. Moreover, the sign same about the portion same also about other portions as drawing 3 is attached, and a different portion is explained. In drawing 1 , 14 is a timer circuit and 15 is a pulse width equalization circuit.
[0014] In the circuit shown in drawing 1 , if a timer circuit 14 repeats ON and OFF a fixed period, an oscillator circuit 12 will interlock, when a timer circuit 14 is ON, an oscillator circuit 12 oscillates, when a timer circuit 14 is OFF, an oscillator circuit 12 suspends an oscillation and a timer circuit 14 and an oscillator circuit 12 repeat this operation. Since drive circuit A11a and drive circuit B11b output the signal switching elements 10a and 10b are made ON-OFF [ a signal ] by turns like the conventional example based on the signal from an oscillator circuit 12 when a timer circuit 14 is ON, as shown in drawing 2 , alternating current flows during TAC. although an oscillator circuit 12 suspends an oscillation on the other hand when a timer circuit 14 is OFF, in order that switching element 10a may continue ON and switching element 10b may continue OFF -- current -- capacitor 6a-> -- -ed -- it flows with weldment 7 -> arc load 8 -> electrode 9 -> switching element 10b, and as shown in drawing 2 , the direct current of electrode side minus flows during the TDC
[0015] Thus, the mixed current on which alternating current and a direct current flow by turns according to ON-OFF of a timer circuit 14 can be acquired easily. Therefore, it is dependent on a time limit setup of a timer circuit 14, and direct-current period ratio =TOFF/(TON+TOFF) =TDC/(TAC+TDC) can be chosen freely.
[0016] Moreover, if the pulse width at the time of oscillation operation of an oscillator circuit 12 is narrowed with the pulse width equalization circuit 15 even when the above-mentioned direct-current period ratio is fixed Since the pulse width of drive signal circuit A11a is narrow, the pulse width of drive signal circuit B11b becomes large, the flow term of switching element 10b spreads in connection with it and the ratio of the current of electrode side minus becomes large The same effect as having enlarged the direct-current period ratio is acquired, the period ratio of hot cathode electric discharge becomes large, the directivity, the increase of stability, and the

electrode heating effect of an arc become small, and an electrode wear is suppressed.
[0017]
[Effect of the Invention] by repeating periodically an alternating current period and the direct-current period of electrode side minus by turns according to this invention so that clearly from the above explanation, attributing the ratio of a direct-current period size, and performing arc welding The period ratio of hot cathode electric discharge becomes large, and since the pole is stabilized by this period, the directivity of an arc and its stability increase, it makes easy fillet weld and Uranami welding, such as aluminum and magnesium, decreases the electrode heating effect which is generated in electrode side plus, and suppresses an electrode wear. Furthermore, by preparing a direct-current period, the generating harmonic at the time of inversion decreases, and it is effective in reducing arc sound.

## OPERATION

[Function] By the above-mentioned composition, the direct current of electrode side minus will be periodically mixed by conventional alternating current, and an alternating current property will be joined by the direct-current property of electrode side minus. Since an electrode turns into hot cathode in the period of electrode side minus and the pole is stabilized by this, the increase of the directivity of an arc and an arc are stabilized, and there is no electrode heating effect like [ in the case of being electrode side plus ], and exhaustion of an electrode is suppressed. Moreover, since there is no inversion at the time of direct-current mixture, the noise by the higher harmonic is lost, and arc sound decreases.

## EXAMPLE

[Example] Hereafter, it explains, referring to a drawing about one example of the AC arc welding machine of this invention.

[0013] In drawing 1 , since main circuit composition is the same as drawing 3 which shows the conventional example, the upstream of the welding transformer 4 has been omitted. Moreover, the sign same about the portion same also about other portions as drawing 3 is attached, and a different portion is explained. In drawing 1 , 14 is a timer circuit and 15 is a pulse width equalization circuit.

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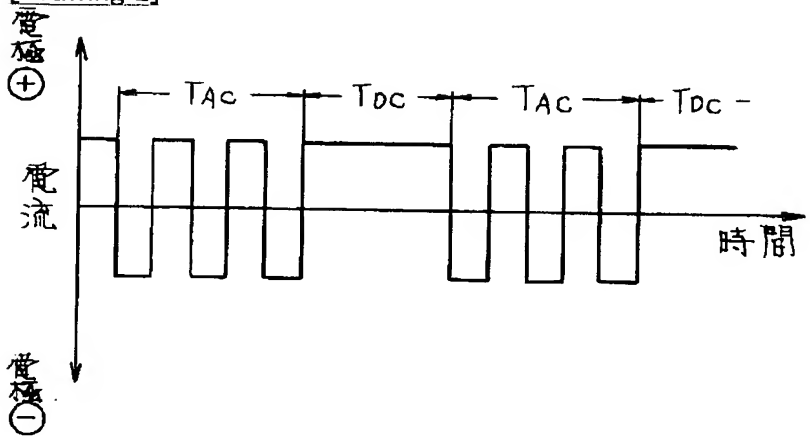
## DESCRIPTION OF DRAWINGS

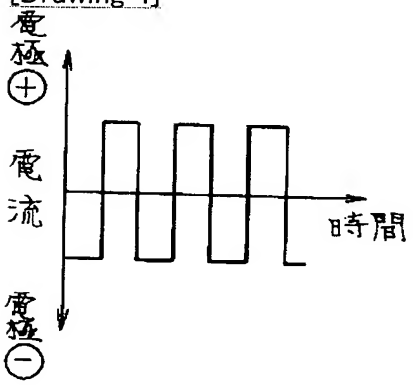
[Brief Description of the Drawings]
[Drawing 1] The circuitry view showing one example of the arc welder of this invention
[Drawing 2] The wave form chart of the output current in this example
[Drawing 3] The circuitry view in the conventional example
[Drawing 4] The wave form chart of the output current in the conventional example
[Description of Notations]
4 Welding Transformer
5 Rectifier Diode (Rectifier Circuit)
6a, 6b Capacitor
7 Weldment-ed
8 Arc Load
9 Electrode
10a, 10b Switching element
11a Drive signal circuit A
11b Drive signal circuit B
12 Oscillator Circuit
14 Timer Circuit
15 Pulse Width Equalization Circuit

DRAWINGS

[Drawing 2]

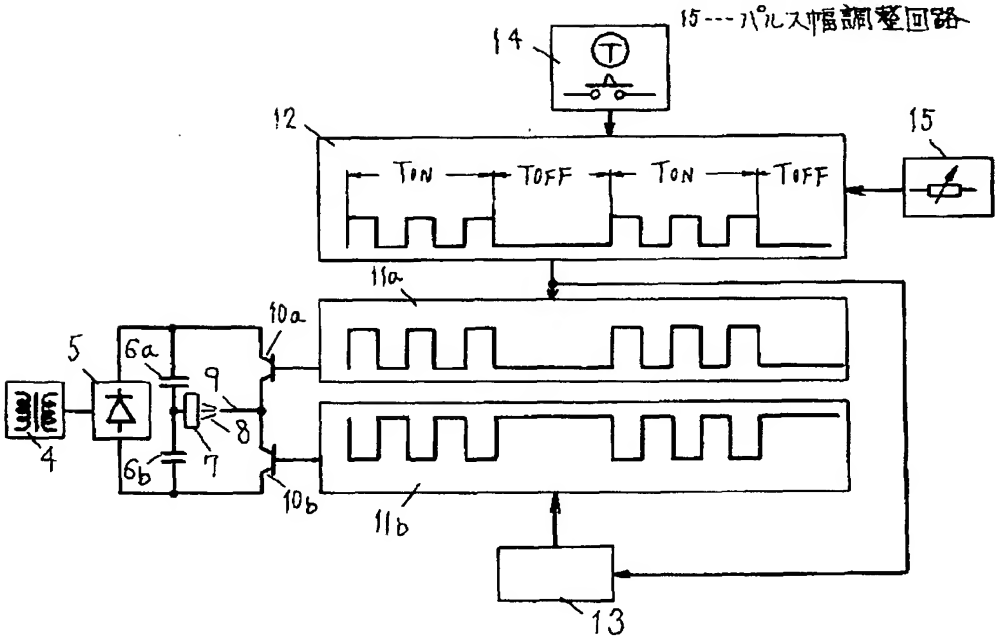



[Drawing 4]




[Drawing 1]

4 --- 溶接トランス
5 --- 整流ダイオード(整流回路)
6a,6b --- コンデンサ
7 --- 被溶接物
8 --- アーク負荷
9 --- 電極
10a,10b --- スイッチング素子
11a --- ドライブ信号回路A
11b --- ドライブ信号回路B
12 --- 発振回路
14 --- タイマー回路
15 --- パルス幅調整回路




[Drawing 3]